

Extending the Boundaries:

The Mobile Digital Campus at Drexel and Philadelphia



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QuestNet 2005

Hyatt Regency Coolum Beach

•
Queensland, Australia
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Drexel Snapshot



- ▣ Private institution founded in 1891
 - ❖ *Urban campus in central Philadelphia*
 - ❖ *Cooperative-education program*
 - ❖ *Technology focus*
- ▣ History of technological firsts
 - ❖ *Computer requirement for all students, '83*
 - ❖ *Major completely wireless campus net, '00*
- ▣ Provider of services to ≈50 other schools
 - ❖ *Took over MCP & Hahnemann in 2002*
 - ❖ *Admin for 3; Academic for 30+; I2 for 14*

Drexel IT Environment

- Near-corporate model
 - ❖ *Quick decisions to leverage short life cycles*
- Centrally fund emerging technologies
 - ❖ *Charge-backs act as disincentive to adoption, use, and innovation*
- Partner when possible
 - ❖ *Guide development direction*
 - ❖ *Get jump start on integration*

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Business School

How Dr. Papadakis Runs a University Like a Company

By BERNARD WYSOCKI JR.

PHILADELPHIA—At a Drexel University campus forum last May, professors complained about funding cuts at the library. Rather than apologize for the belt-tightening, President Constantine Papadakis told them he'd prefer to have an all-digital library with no books at all.

Some faculty members and students were horrified. An architecture professor said printed books were essential to his field. Another professor compared the Drexel library to that of a community college. "It boggles the mind that someone like a university president could envision a library without books," wrote the student newspaper, the Triangle, in an editorial.

In an interview, Dr. Papadakis says he was exaggerating to make a point: Spending too heavily on books, periodicals and the buildings that house them is a waste in the digital era.

Wall Street Journal, 23 Feb 2005



Constantine Papadakis



Tomorrow's Students Expect More Technology from Colleges

- Already have PCs, broadband Internet, mobile phones
- Already function as in-home TIO – "Teenage Information Officer"
 - Antonoff 4/02
- Already handing off role to younger and younger siblings



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Building DragonFly

Planning

Building

Nurturing



802.11 Options



- ▣ 802.11b – The Old WLAN
 - ❖ *The only standard available in 2000*
 - ❖ *Slow, noisy spectrum*
 - ❖ *Lots of signal distribution options*
- ▣ 802.11g – The Home WLAN
 - ❖ *Fast, noisy spectrum; taking over for “b”*
- ▣ 802.11a – The Office WLAN
 - ❖ *Fast, quiet spectrum; capturing biz market*
 - ❖ *Low range, many channels, low overlap*
 - ❖ *Distribution options growing*

Introducing Mobile Networking to a Campus

- ▣ Target early adopters
 - ❖ *Students first*
- ▣ Generate “buzz” in high-profile pilot project locations
 - ❖ *Library and student café in 1998*
- ▣ Support adoption through underwriting
 - ❖ *Provide infrastructure at no charge*
 - ❖ *Subsidize wireless adapters for students*



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Supply Push vs. Demand Pull

- ▣ If you build it, they will come...
 - ❖ *Building the network before there are users will “spontaneously” create users*
- ▣ If cost of participation is reasonable
 - ❖ *Laptops and wireless cards weren’t affordable when we started – they are now*
- ▣ Once the user base reaches a critical mass, users will “sell” their peers

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DragonFly kick-off: June 2000



- ▣ President commits funds for a full-scale multi-campus wireless project
- ▣ Pennsylvania provided financial assistance
- ▣ **Phase 1** provides service **coverage** everywhere inside and outside
- ▣ **Phase 2** to provide additional **capacity** to better support high-use areas
- ▣ Started late due to delivery difficulties
 - ❖ *Finished early due to good luck and good staff*

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CNN Introduction to DragonFly



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Taped: August 2000

Aired: November 2000

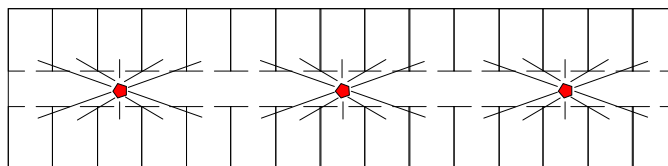
DragonFly Indoor Construction

- ▣ Site survey essential before deployment
 - ❖ *Placement for pilot projects less important*
- ▣ AP placement shifting from art to science
 - ❖ *Begin with one person holding AP and another holding PC, then map signal*
 - ❖ *"Biopsy" buildings to learn what's inside walls*
- ▣ Use external antennas to extend b/g range
- ▣ Factor in *quantity* and *type* of users

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The Problem With Dorms

- ▣ Residence halls have many small rooms
 - ❖ *Rooms are separated by walls*
- ▣ Walls attenuate signal
 - ❖ *Lots of attenuation shorten range*
- ▣ Short range mandates many access points
 - ❖ *Many APs cause overlapping signal problems*



Floor plan of typical old-style residence hall

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Dealing with Dorms

Leaky Coax to the Rescue

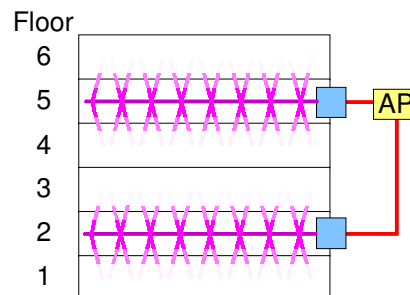
- ▣ Stretch the antenna past the walls to eliminate the problem
- ▣ Amplifiers are needed to boost signal on the line
- ▣ Reach can be great, but users are still sharing a single antenna



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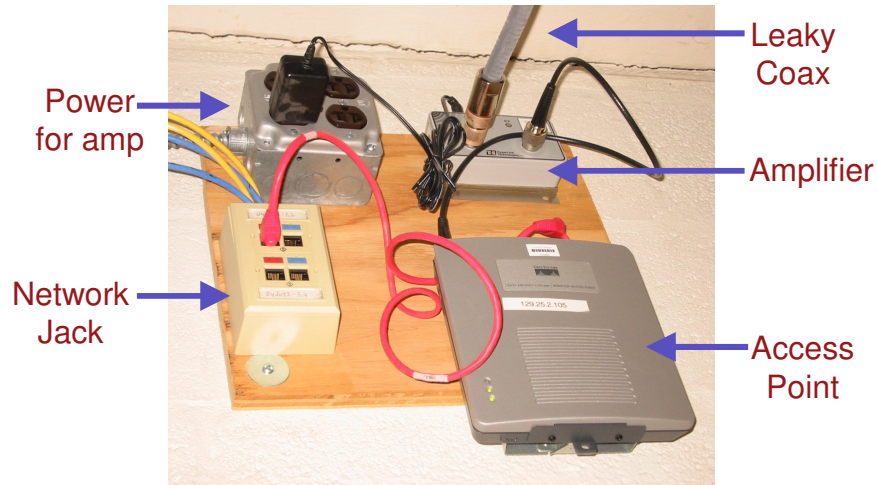
Multi-Floor Coverage vs. Capacity

- ▣ Six-storey building
 - ❖ 300 residents
- ▣ Single-closet installation
 - ❖ One AP w/dual radios
 - ❖ Two amplifiers (blue)
 - ❖ Two leaky cables (purple)
- ▣ Signal strength is sufficient to reach one floor in each direction
- ▣ Design provides for easily quadrupling of capacity
 - ❖ Stage 2: use one AP for each leaky cable
 - ❖ Stage 3: split each line into two segments



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Matheson Hall Implementation

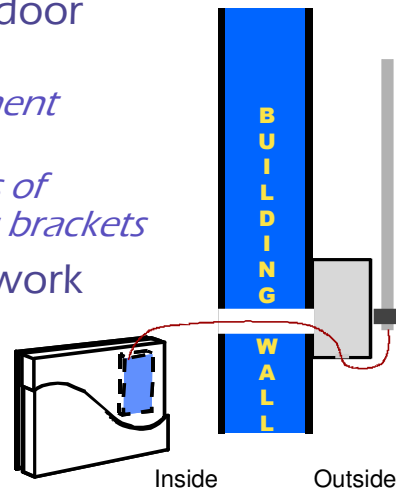


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DragonFly Outdoor Construction

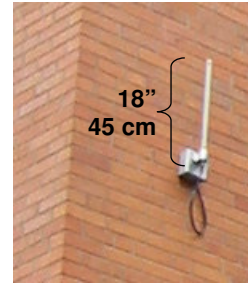


- ▣ Developed indoor/outdoor mounting technique
 - ❖ *Keeps electrical equipment inside the building*
 - ❖ *Minimizes visible effects of antenna and mounting brackets*
- ▣ Designed outdoor network for 400' service radius
 - ❖ *Over engineered by a factor of 2-4 times*



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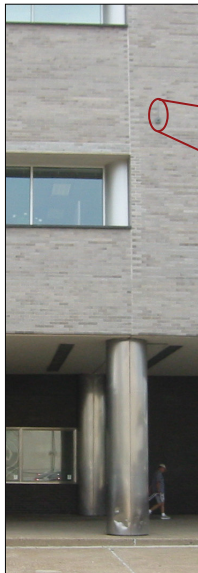
Outdoor Antenna Mount



- Antennas usually mounted mid-2nd floor

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Outdoor “Hidden” Mount



- Antennas don't have to ruin a façade



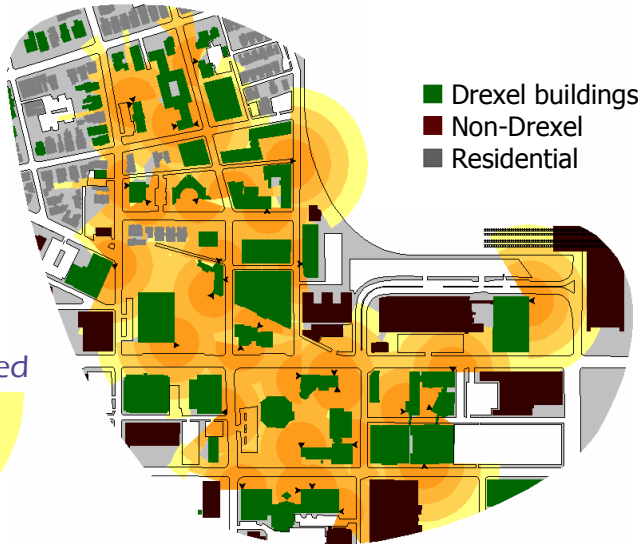
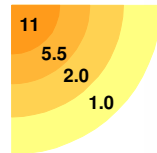
- Disguise them to quiet aesthetic complaints

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DragonFly 802.11b Coverage

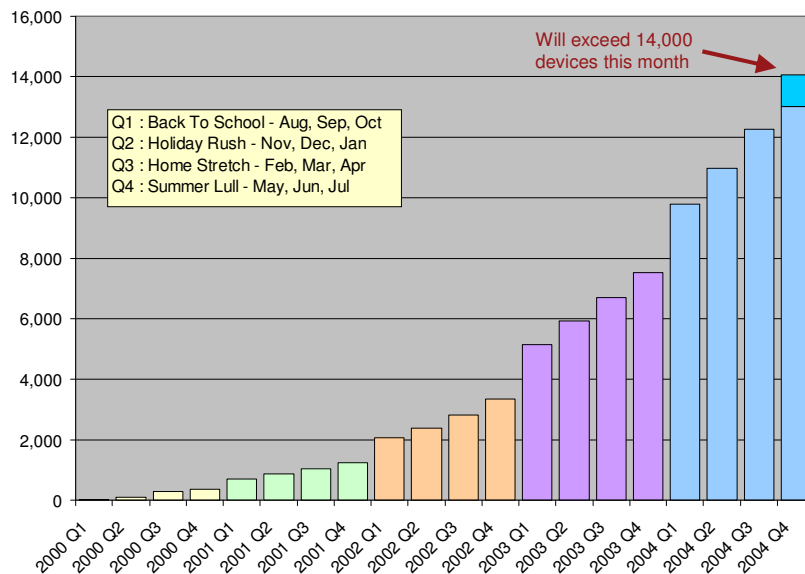


- 250 access points
- 300 indoor antennas
- 35 outdoor antennas
- Color shows speed (Mbps)



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DragonFly Registrations



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DragonFly II: Born: 2004, Died: 2006?

- ▣ Upgraded to support 802.11 a/b/g
 - ❖ *All DragonFly equipment replaced in 2004*

DragonFly II

802.11a 802.11g

- ▣ Upgrade to improve security
 - ❖ *WPA testing complete*
 - ❖ *Full roll-out within eight weeks*
- ▣ Planning to replace hardware in '06/'07

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Wireless Philadelphia

Goals

Politics

Plans



Mayor's Vision

- ▣ Expand Internet access to the entire city
 - ❖ *135 square miles (350 m2)*
- ▣ Spur economic development
 - ❖ *By delivering service to "opportunity zones"*
- ▣ Shrink the digital divide
 - ❖ *By providing PCs, training, and access to underserved/disadvantaged groups*
- ▣ Reduce the cost of government
 - ❖ *By moving circuits onto our own network*

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Study Results

- ▣ The need for universal service is real
 - ❖ *Wireless technology is the most cost effective way to address these needs*
- ▣ There is a potential paying market
 - ❖ *Private sector may never meet need*
- ▣ Success rate of a public/private partnership will be greater than either side going alone
 - ❖ *The City needs to bootstrap the process*

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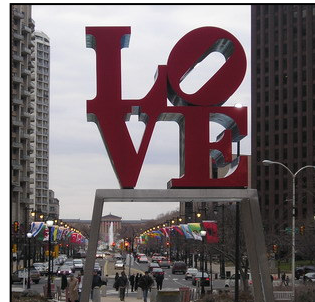
Wireless Philadelphia Finances

- Start-up: Borrow US\$ 10 million
 - ❖ *To deploy broadband wireless at dial-up prices*
- Operations: Borrow US\$5 million
 - ❖ *To support and grow for three years*
- Ongoing: Break even, repay loans, grow
 - ❖ *Build US\$4 million for network upgrades*
 - ❖ *Generate US\$5m for economic development, digital divide reduction programs*

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Love Park Pilot Project

- Nestled between City Hall and Art Museum
 - ❖ *Skateboard heaven/hell*
 - ❖ *Free wireless set up last year*
- 2,600 users since registered
 - ❖ *User count growing 20% a month*
- Extended from City Hall to Art Museum
 - ❖ *Serving as first test-bed for the city-wide project*



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Implementation Plan

- 
- Create a nonprofit to operate the network
 - ❖ *Outsource design, deployment, maintenance*
 - ❖ *Provide free access in major parks*
 - ❖ *Fund econ. dev. and digital divide programs*
 - Four “WISPs” provide retail service
 - City provides access its assets
 - City contracts with Nonprofit for service

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Political Blockade

- Telcos lobby legislature to block competition
 - ❖ *In November 2004, House Bill 30 proposed restrictions on local political subdivisions planning to offer broadband service for a fee in section H:*
 - (1) Except as otherwise provided for under paragraph (2), a political subdivision or any entity established by a political subdivision may not provide to the public for compensation any telecommunications services, including advanced and broadband services, within the service territory of a local exchange telecommunications company operating under a network modernization plan.

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Political Compromise?

- Intense local lobbying resulted in an exemption
 - ❖ *(2) A political subdivision may offer advanced or broadband services if the political subdivision has submitted a written request for the deployment of such service to the local exchange telecommunications company serving the area and, within two months of receipt of the request, the local exchange telecommunications company or one of its affiliates has not agreed to provide the data speeds requested. If the local exchange telecommunications company or one of its affiliates agrees to provide the data speeds requested, then it must do so within 14 months of receipt of the request.*
- Telcos may take 24 more months to complete projects before cities can do it for themselves

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Minimal Impact

- Verizon waived its right of first refusal, allowing the initiative to move forward.
 - ❖ *Agreement includes a non-litigation clause*
- Business model works with private industry, not in competition with it
- Other municipalities not so lucky
 - ❖ *Must negotiate with own exemption*

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RFP Process

- ▣ Six qualified bids received in June
 - ❖ *AT&T*
 - ❖ *Cellnet/WFI*
 - ❖ *Clearwire*
 - ❖ *Earthlink*
 - ❖ *HP*
 - ❖ *Sprint*
- ▣ Responses evaluated by financial and technical



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Timeline for Go-Live

- ▣ July, 2005
 - ❖ *Finalists selected for contract negotiations*
- ▣ August, 2005
 - ❖ *Contract(s) executed*
- ▣ September, 2005
 - ❖ *Construction starts*
 - ❖ *Segments come online as they are finished*
- ▣ September, 2006
 - ❖ *Network completed !*

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A Different Kind of Wireless

Anytime
Anywhere
With Anything



Extending the Boundaries: DrexelOne Mobile



- ▣ Any time access to eServices – 24 x 7
- ▣ Anywhere – no geographical boundaries
- ▣ On any network – from any provider
- ▣ With any thing
 - ❖ Laptops
 - ❖ Handhelds
 - ❖ Cell Phones
- ▣ Oh, yeah, in 10 days!



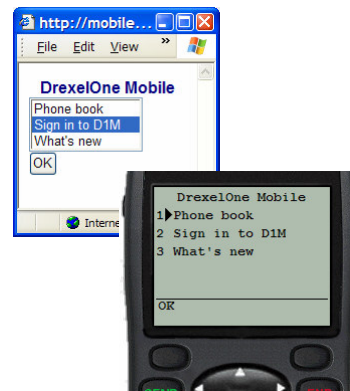
Mobile Design Principles

- ▣ User input must be minimized
 - ❖ *Input devices less capable than PC's*
- ▣ Output mustn't require much formatting
 - ❖ *Device capabilities limited, vary widely*
- ▣ Info must be time-critical to specific user
 - ❖ *Better alternatives available with more time*
- ▣ Mobile apps should be supplemental
 - ❖ *Web app can offer better UI, more features*
 - ❖ *No feature should require a mobile device*

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Birth of a Portal

- ▣ Initial private build: 5 days
- ▣ Initial public offering: 5 days later!
- ▣ Connects to
 - ❖ *SCT Banner ERP system*
 - ❖ *SCT Luminis portal*
 - ❖ *Oracle, MS SQL, MySQL*
 - ❖ *3 web services*
- ▣ Toolbox
 - ❖ *Visual Studio .NET*
 - ❖ *Windows Server with IIS*
 - ❖ *.NET framework*

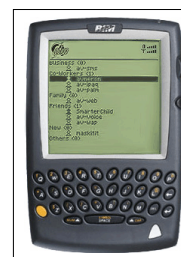


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DrexelOne Mobile eServices

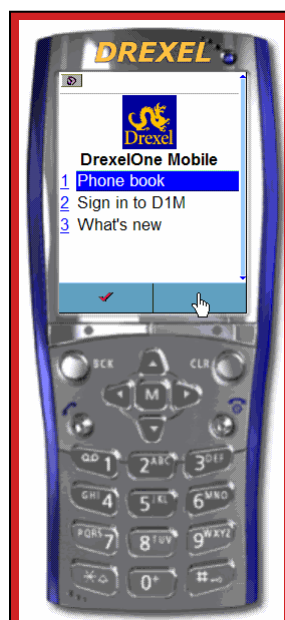


- Common Authentication with D1
- Push & Pull Announcements
- Grades and Course Schedules
- Calendar events and tasks
- Directory Services
- Headline News



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Demonstration



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Conclusion

Lessons Learned

Futures

Q&A



Marketing ≠ Engineering



- ▣ 802.11 still an immature technology
 - ❖ *Life cycles are very short, but getting longer*
 - Drexel is on its fourth generation of access point and sixth generation of cards since 1997
- ▣ Marketing claims still exaggerated
 - ❖ *Performance*
 - Throughput is really about 50% of claim
 - "b" users really drag down "g" performance
 - ❖ *Range*
 - 1,750 ft "b/g" range is wildly optimistic
 - Drexel engineered for 400 ft outside

General Lessons Learned

- ▣ Technology is meaningless until you define a need that it satisfies
 - ❖ *Get academic buy-in before committing*
- ▣ Be ubiquitous or don't do a wireless project
 - ❖ *Underwrite or centralize the infrastructure costs*
- ▣ Take charge of the RF spectrum
 - ❖ *"Unlicensed" can quickly become "unstable"*
- ▣ Plan on two phases – coverage then capacity

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Indoor Wireless Lessons

- ▣ People value convenience over speed
- ▣ Wired is and will stay faster
 - ❖ *Wired Gig-E is the new standard on PCs*
- ▣ Wireless good for non-synchronized use
 - ❖ *Not so good for teaching labs*
- ▣ Human bodies block signal effectively
- ▣ Skills will improve quicker than expected
 - ❖ *Experienced staff can place APs from blue prints and discussions of building materials*

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Outdoor Wireless Lessons

- ▣ Trees/leaves block wireless signal
 - ❖ *Do site surveys after spring, before fall*
- ▣ Where people sit to use computers is different than where they sit to socialize
 - ❖ *Do a small initial installation to learn those differences, then do full roll-out*
- ▣ Be thoughtful of aesthetic issues
 - ❖ *Shrink, hide or disguise antennas*

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What's Next for DragonFly?

- ▣ Complete roll-out of 802.11a by August
 - ❖ *Fill-in "holes" in CY2006*
- ▣ Upgrade security to WPA by August
 - ❖ *Replacing WEP and VPN*
- ▣ Integrate infrastructure with WiFiPhilly???
 - ❖ *Give Drexel users access anywhere in Phila.*
- ▣ Begin consideration of 802.11n
 - ❖ *Each generation is still only good for 3-4 years*

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What's Next for D1 Mobile?

- ▣ Full email, better calendar integration (Q4)
 - ❖ *Email (in beta now); calendar enhancements*
- ▣ One-card integration (2006)
 - ❖ *Balance check, recent transactions, add funds*
- ▣ Provide IM; integrate SMS?
 - ❖ *Links services where possible (partnership op?)*
 - ❖ *Improves communications and collaboration*
- ▣ Voice integration (2006?)
 - ❖ *Eliminates need for net-connected device*
 - ❖ *Text-to-speech and speech recognition*

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Q & A



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July and January from a Dragon's Point of View

